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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No.:	10/613,233
Application Filing Date:	July 3, 2003
Title:	Failure Tolerant Passive Lubrication System.
Docket Number:	EH-10953
Applicant(s):	William G. Sheridan
Examiner:	David M. Fenstermacher
Art Unit:	3682

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF DR. J. AXEL GLAHN
UNDER 37 § CFR 1.132

I, Dr. J. Axel Glahn, declare as set forth below:

1. On October 22, 1990, I was awarded a Dipl.-Ing. degree in Mechanical Engineering (the equivalent of a Master of Science degree) by the Universität Karlsruhe in Karlsruhe, Germany. My thesis was "Entwicklung eines Meßsystems zur Bestimmung des Geschwindigkeitsvektors in dreidimensionalen Strömungen" ("Development of a Pneumatic Method for Velocity Measurements in Three-Dimensional Flow Fields")

2. On November 17, 1995, I was awarded a Dr.-Ing. degree in Mechanical Engineering by the Universität Karlsruhe in Karlsruhe, Germany. My dissertation was "Zweiphasenströmungen in Triebwerkslagerkammern - Charakterisierung der Ölfilmströmung und des Wärmeübergangs" ("Two Phase Flow in Aero-engine Bearing Chambers - Characterization of Oil Film Flows and Heat Transfer").

3. From February 1986 to April 1996 I served as a graduate research assistant and then as a research engineer at the Institut für Thermische Strömungsmaschinen, University of Karlsruhe, Germany. My work included experimental and analytical investigations related to fluid flow, heat transfer and oil distribution in bearing compartments.

4. From May 1996 to September 1997 I served as a scientist in the Heat Transfer Group at ABB Corporate Research Ltd. in Baden- Dättwil, Switzerland. My work included the application of experimental, numerical and analytical techniques to problems related to gas turbine engine internal air systems.

5. From November 1997 to June 1998 I served as a development engineer at ABB Power Generation Ltd. in Baden, Switzerland. My work included data assessment, model development and model validation related to gas turbine engine internal air systems.

6. From July 1998 to July 2001 I served as a research engineer and later as a senior research engineer at the United Technologies Research Center in East Hartford, Connecticut. My work included experimental efforts related to bearing compartment two-phase fluid dynamics as well as development of physics based models for lubrication system analysis.

7. From July 2001 until the present I have been employed at the Pratt and Whitney division of United Technologies Corporation in East Hartford, Connecticut. Until very recently I served as the manager of system analysis in the mechanical systems department of Pratt & Whitney's Combustor, Augmentor and Nozzle Module Center. My work included lubrication system and bearing compartment heat transfer analysis. I also supervised and mentored a group of about ten engineers.

8. On August 16, 2005 I was named Manager, Technology Development and Integration, in the Air Systems Design and Integration organization of Pratt and Whitney.

9. I am a member of the American Society of Mechanical Engineers and of the International Gas Turbine Institute. In 1997 I was elected a member of the Institute's Heat Transfer Committee.

10. In 1996 I received the FAG Kugelfischer-Foundation Award for best dissertation work on bearing technology. In 1997 I received the FAG Kugelfischer-Foundation Main Award (3rd Rank) for outstanding contributions to bearing technology research.

11. I am named as an author or co-author on thirteen publications. A list of these publications is attached hereto as Exhibit A.

12. I am named as an inventor or co-inventor on three United States Patents. A list of these patents is attached hereto as Exhibit B.

13. As a result of my accumulated academic and professional experience I have developed expertise in fluid flow and heat transfer in rotating machinery and in gas turbine secondary air and lubrication system analysis.

14. In connection with this declaration I have familiarized myself with the contents of the above captioned patent application, the pertinent portions of the Office action mailed on June 24, 2005, US Patent 4,373,421 (US '421) and US Patent 4,858,427 (US '427).

15. I understand that the June 24 Office action rejects claims 1-14 of the application as unpatentable over a primary reference (US '421) in view of a secondary reference (US '427). In particular, the Office action acknowledges that the primary reference fails to disclose an emergency lubricator that functions under normal (non-emergency) operating conditions. The Office action also points out that the device of the secondary reference has a secondary system that operates concurrently and in parallel with the primary system. The Examiner concludes that, in view of '427, it would have been obvious to modify the

lubrication system of '421 so that it operates at all times.

16. However it is my opinion that the device of '421 would be rendered unsatisfactory if it were modified to operate at all times. In support of my opinion I offer the following remarks.

17. The primary reference, US '421, describes two variants of an aerosol lubrication system. Consider first the variant shown in FIG. 1. Chamber 8 is prefilled with a fixed quantity of oil, but is not connected to a continuous supply of oil. The fixed quantity is enough to last about 20 minutes. See col. 3, lines 61-65. If the device of FIG. 1 were allowed to operate at all times, the oil in chamber 8 would be quickly depleted during normal operation so that no oil would be available to sustain engine operation in an emergency. This would render the device unsuitable for providing oil in the case of accidental oil drainage from the main lubricating unit, which is the intended purpose expressed at col. 1, lines 22-25.

18. In addition, the '421 patent teaches that the oil reserve must be leak tight, i.e. that it must not allow reserve oil to flow back into the regular lubrication system during non-emergency, negative-g or inverted flight (col. 2, lines 37-41). To achieve this goal, the device inlcudes a tube 17 that "plays the role of a clack valve" (col. 3, lines 2-3). The clack valve cooperates with tube guides 11a and 22 to define valves 35 and 36. Valve 35 resides in the partition 12 between chambers 8 and 10; valve 36 resides in partition 11 between chambers 8 and 9

(col. 3, lines 44-48). The purpose of the clack valve (i.e. of valves 35, 36) is, among other things, "to prevent any migration of oil out of container 1 in inverted or 'negative g' flight" (col. 4, lines 25-32, particularly lines 30-32) during non-emergency operation. In other words, during non-emergency operation valve 36 prevents oil from entering chamber 9 and therefore prevents oil from being supplied to the venturi 2 by way of tube 19.

19. In order for the venturi 2 to also operate during non-emergency conditions (in addition to operating during emergency conditions) it would be necessary to supply oil to chamber 9 during non-emergency operation so that feed member 19 would be in communication with the oil during those non-emergency conditions. However doing so would allow oil migration out of the container during non-emergency inverted or negative-g flight. But this is contrary to the teachings and purpose, stated in the reference, of "[preventing] any migration of oil out of container 1 in inverted or 'negative g' flight" (col. 4, lines 30-32). This is a second reason why the proposed modification of the FIG. 1 device (to allow it to operate at all times, not just under emergency conditions) would render it unsatisfactory for its intended purpose.

20. Next consider the variant shown in FIGS. 2 and 3. This variant does not have a clack valve. In addition, connection 56 continuously supplies oil to chambers 53, 54 under non-emergency conditions.

21. During non-emergency operation oil fills chambers 53 and 54 and tube 64 serving bearing 65 (col. 5, lines 17-

21). However air does not flow to the venturi because gate valve 4 is closed (col. 5, lines 31-32). During emergency operation, when the oil supply to connection 56 is interrupted, the aircraft pilot activates a switch, causing valve 4 to open and admit air to the venturi. The venturi then aspirates reserve oil from chamber 53 until that oil is depleted. In summary, during normal operation chamber 54 receives bulk oil, but no air. During emergency operation chamber 54 receives an air/oil mist from the venturi, but no bulk oil. In other words chamber 54, as envisioned by its inventors, does not receive air from the venturi concurrently with bulk oil.

22. Suppose, however, that the device were modified so that the venturi operated during non-emergency conditions. Air would flow through the venturi and into chamber 54. However, this air would carry very little oil, as explained below. At the same time, bulk oil arriving at connection 56 would continue to flow to chamber 54. Consequently, chamber 54 and oil outlet tube 64 would receive a mixed medium comprising liquid bulk oil and air. This mixed media flow causes a high pressure loss in tube 64 and, as a result, elevates the pressure in chamber 54. This phenomenon is well known and is described further in Exhibit C. But the venturi requires a relatively low pressure in chamber 54 in order to operate properly. Because the venturi instead encounters an abnormally high pressure in chamber 54, the venturi discharges mostly air, possibly with a small amount of oil, into the chamber 54. As a result, the bearing receives, by way of tube 64, a poor quality, mixed media flow of oil and air with agglomerations of oil. This mixed media flow is

unsatisfactory for effectively lubricating and cooling the bearing during normal operating conditions.

23. In addition, if the device were modified so that the venturi operated at all times, there would be no need for valve 4. If the oil pressure is high enough relative to the air pressure, the oil could, in the absence of valve 4, backflow through the venturi and contaminate the blower 5 (or whatever other device is supplying the pressurized air).

24. Finally, it also appears that if the venturi were operating while oil was being supplied to connection 56, the dominant oil flow path to chamber 54 would be directly from connection 56 through hole 73, not through chamber 53 and tube 62. As a result, it would take a long interval of time to refresh the oil in chamber 53. This is contrary to the stated goal of refreshing the oil continuously (col 5, lines 60-63).

25. In summary, the device of FIGS. 2 and 3 is intended to operate with chamber 54 receiving either bulk oil (non-emergency operation) or an air oil mist discharged from the venturi (emergency operation). But it is not intended to operate in a mixed-media mode where both bulk oil and compressed air from the venturi are both able to enter the chamber 54. Such mixed-media operation renders the device unsuitable for its intended purpose.

26. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and

further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: September 1, 2005

Dr. J. Axel Glahn